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Accuracy of pH test strips for gastric juice testing

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1. Abstract

pH test strips are used to measure pH of gastric juice when checking correct placement of enteral feeding tubes. Study data show, that pH test strips provide a good means to measure pH of gastric aspirate. However, in the hand of the intended users, instrument reading of test strips is significantly more accurate than visual reading.

2. Introduction

The pH of gastric juice is used to check the correct placement of enteral feeding tubes. Different pH test strips can be used for this evaluation. Recently, the first automatic strip reader was introduced. In this study we evaluated two aspects of accuracy:

a) The accuracy of different devices in the hands of lab personnel when testing real human gastric juice samples with respect to a pH-meter.
b) The accuracy of different devices in the hands of intended users when testing buffer solutions.

The final accuracy is a combination of both.

3. Testing of real human gastric juice samples by lab personnel

Approximately 120 gastric juice samples were collected from volunteers over a period of 2 weeks. The pH of these samples was tested with a calibrated pH meter, 3 different visually read test strips and one instrumentally read test strip. All strip tests were done in triplicates by experts.

The test strip reading was valued as correct, when the strip reading was within 0.5 pH units of the pH-meter reading. That means, for example, if the pH-meter reading was 4.2 then strip readings of pH = 4.0 and pH = 4.5 were counted as correct.

ENT-pHX visual evaluation

	#measurements	correct ± 0.5 pH-units	in %
all measurements	357	341	96%
samples with pH 4.5-6.5	42	42	100%

ENT-pHX instrumental evaluation with pHX-act

	#measurements	correct ± 0.5 pH-units	in %
all measurements	357	349	98%
samples with pH 4.5-6.5	42	42	100%

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pHX2-9 visual evaluation

	#measurements	correct ± 0.5 pH-units	in %
all measurements	357	346	97%
samples with pH 4.5-6.5	42	39	93%

pHX0-6 visual evaluation

	#measurements	correct ± 0.5 pH-units	in %
all measurements	339	329	97%
samples with pH 4.5-6.5	42	42	100%

The results of pH test strips for gastric juice are very good when compared to a calibrated pH meter. For ENT-pHX visual and instrumental evaluation and pHX0-6, 100% of the results in the critical range of pH 4.5-6.5 were correct. In the case of pHX2-9 one sample with a pH of 5.7 was consistently read as 6.5 (all three tests).

4. Testing of buffer solutions by intended users

In a blinded study, 10 intended users were provided with different buffer solutions. They used the different devices to test the pH.

ENT-pHX visual evaluation

pH-value	#samples	correct reading	correct ± 1 color block
2	10	9	10
3	10	7	9
4	20	5	20
5	10	7	9
6	20	19	20
7	10	6	10
8	10	10	10
9	10	10	10
Sum	**100**	**73**	**98**
		73%	**98%**

ENT-pHX instrumental evaluation with pHX-act

pH-value	#samples	correct reading	correct ± 1 color block
2	10	10	10
3	10	5	9
4	20	19	20
5	10	10	10
6	20	20	20
7	10	10	10
8	10	10	10
9	10	10	10
Sum	**100**	**94**	**99**
		94%	**99%**

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pHX2-9 visual evaluation

pH-value	#samples	correct reading	correct ± 1 color block
2	10	8	10
3	10	5	7
4	20	11	20
5	10	9	10
6	20	18	20
7	10	10	10
8	10	9	10
9	10	8	10
Sum	**100**	**78**	**97**
		78%	**97%**

pHX0-6 visual evaluation

pH-value	#samples	correct reading	correct ± 1 color block
0	10	5	10
1	10	9	10
2	10	10	10
3	10	10	10
4	20	11	20
5	10	10	10
6	20	18	20
Sum	**90**	**73**	**90**
		81%	**100%**

With instrument reading, 94% of all results are correct. This is significantly higher than the average of correct readings for visual reading of 77%.

Moreover, with instrument reading 100% of results at pH = 5.0 and pH = 6.0 are correct as opposed to an average of 91 % with the different visual reading devices.

Within ± 1 color block, nearly all results are correct at all levels.

5. Conclusion

The results show, that in the hands of lab personnel, pH test strips are suitable to evaluate the pH of gastric juice. Also, intended users (nurses) in general get very good results when measuring pH with the test strips. However, getting correct results with visual strip reading can be challenging in clinical settings. In a discussion with SMTL Wales, different light conditions were identified as one possible source of errors. In this study, however, the effect of different light conditions could not be further evaluated. Instrumental reading is independent of ambient light. This might explain the comparably very good results.

Instrumental reading is useful

- to lift the burden of visual reading from nurses
- to have results documented in case of incidents
- to have more reliable reading in the critical pH range for tube placement checks.